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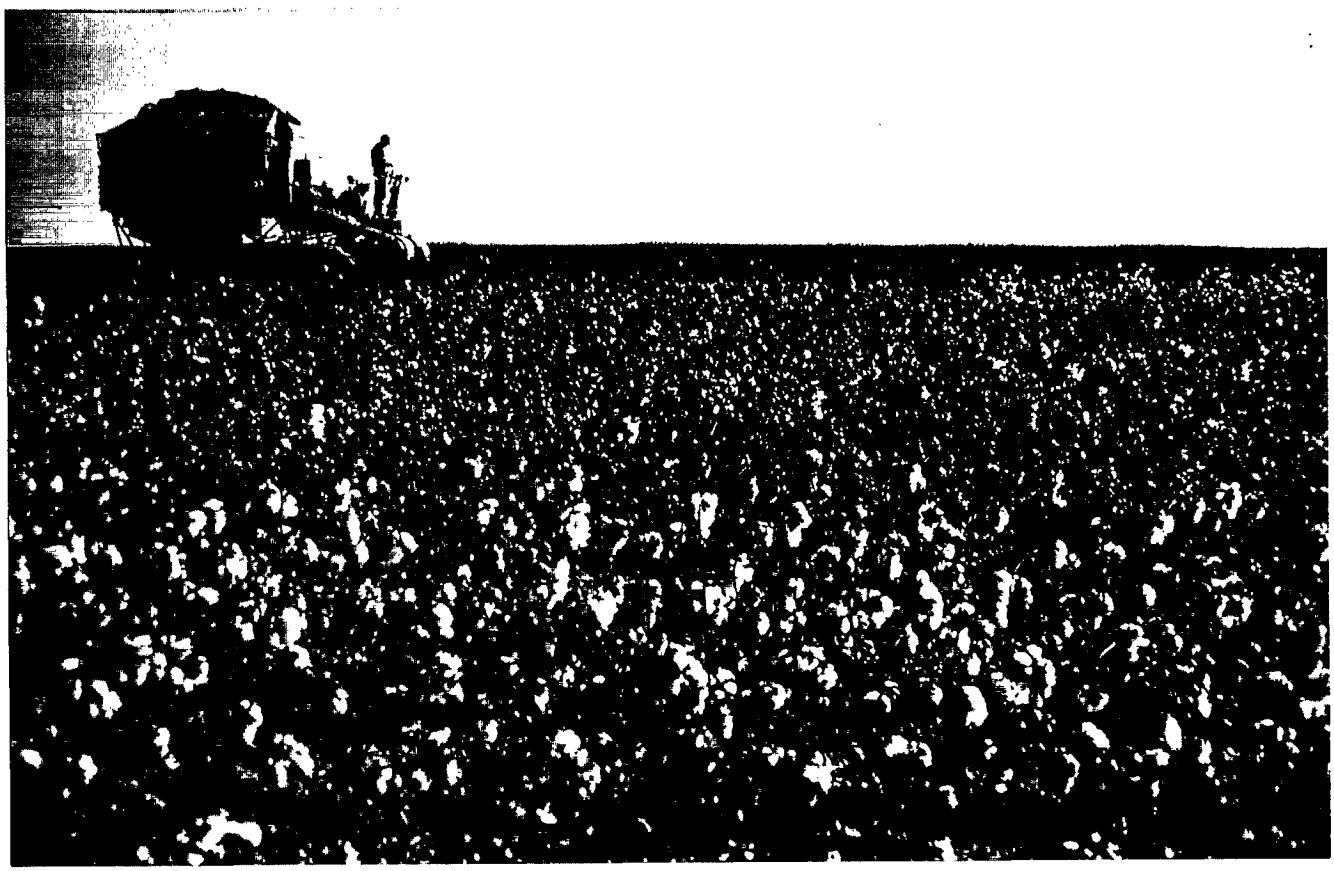

1994 Survey Report of Land Use in Fresno County

February 1997

Pete Wilson
Governor
State of California

Douglas P. Wheeler
Secretary for Resources
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David N. Kennedy
Director
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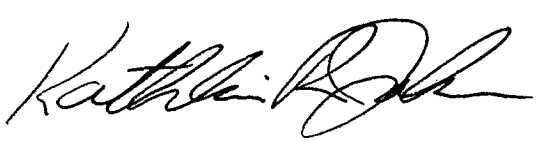
Foreword

Since 1950, the Department of Water Resources has conducted periodic detailed surveys of each of California's 58 counties to identify and quantify categories of land use, focusing on irrigated agricultural acreage. The statewide DWR land use survey data set is unique, and entails greater detail and accuracy than other known, smaller data sets. DWR's primary use of this basic land use information is to develop estimates of current and future local, regional, and statewide agriculture water demands. Land use data also contribute to the development of urban and environmental water demand estimates. Along with corresponding water supply information, these water demands are developed into current and projected regional and statewide water balances for state water resources planning. DWR publishes regional and statewide water balances in the *California Water Plan Update* (Bulletin 160 series), which is revised every five years as required under the California Water Code. The Bulletin 160 series is the state's major statewide water planning document.

This report contains the results of the Department's 1994 survey of the valley floor portion of Fresno County, the most recent of six DWR surveys of Fresno County conducted since 1958. Staff of the Water Conservation and Land and Water Use Section, San Joaquin District, Division of Local Assistance, conducted the field work for this survey. Staff of the Land and Water Use Section, Division of Planning, reviewed the data for accuracy, compiled the data, and completed this report.

Requests for data and other information on this survey may be directed to the San Joaquin District, as indicated in this report.



Kathlin R. Johnson, Chief
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Overview

The State Legislature, in 1947, asked for an investigation of the water resources and present and future needs of all river basins in California. Since then, the Department of Water Resources and its predecessor agencies have been compiling land use statistics. While the first body of information came from such sources as federal agencies, irrigation districts, and county agricultural commissioners, DWR started conducting its own surveys by 1950. DWR has conducted over 250 land use surveys of all or parts of California's 58 counties since 1950.

In the program's early years, surveys were conducted as they were needed for specific investigations, such as the *Northeastern Counties Investigation* (Bulletin 58, June 1960) and the areas of origin studies in the early 1960s (Bulletin 94 series). It wasn't until 1966 that DWR embarked on a regular survey schedule that continues today. These surveys locate and quantify agricultural land use by specific crops and crop groups, general urban development, and native vegetation. Counties are surveyed on a rotating schedule every several years. Counties with large amounts of irrigated agricultural acreage are surveyed about every five to seven years; counties that are primarily urban and those with less agricultural development are surveyed less often. Each of DWR's four District Offices surveys about two counties per year. For nonsurvey years, DWR Land and Water Use Analysts estimate annual land use acreage using information available from other sources.

In the San Joaquin District, each study area is surveyed every seven years. There have been exceptions, including special drought studies and a survey conducted after the 1983 federal PIK (Payment-in-Kind) program, which greatly reduced field crop acreage for that year. The San Joaquin District study areas include the San Joaquin Valley floor portions of Kern, Tulare, Fresno, Madera, Merced, Stanislaus, and Kings counties. San Joaquin District also surveys all of Monterey, San Benito, and Santa Cruz counties.

Information collected by the regular surveys is required to develop the estimates of present and future water demands for the *California Water Plan Update* (DWR Bulletin 160 series). DWR land use data are useful for other purposes including studies of agricultural drainage problems, water transfer potential, urban encroachment, and groundwater pumping.

In 1992, DWR began using geographic information system technology for the land use survey program to replace the traditional cut-and-weigh method of estimating land use acreage. GIS allows for rapid tabulation and spatial analysis of land use data, and facilitates computer analysis of changes in a given area's land use over time. GIS technology has been applied to recent surveys including the Sacramento-San Joaquin River Delta, the Upper Santa Ana River Drainage Area, and all or parts of 10 counties. As new surveys are conducted using GIS, DWR will be able to readily analyze changes over time. DWR is moving toward more cost-effective procedures that incorporate computer-assisted drawing capabilities with new digital image processing and GIS technologies. Current technology remains cost-prohibitive for mass conversion of the large amount of

historical data files into digital formats; however, DWR will monitor technological developments.

The land use survey process is an effort between the Division of Planning, which provides funding, technical support, and data processing, and the four DWR District Offices (see Appendix 5) within the Division of Local Assistance. The districts conduct field work and work with local water agencies and land owners. Generally, the process entails these steps:

1. Obtain recent aerial imagery (either airplane photography (low elevation), or airplane digital imagery (high elevation), or satellite digital imagery) of the chosen area in mid-growing season, usually late June or early July.
2. Draw land use field and area boundary lines (distinct fields, urban areas, native vegetation, and major features) from aerial imagery onto U.S. Geological Survey 7-1/2 minute quadrangle maps.
3. Assign land use codes (attributes) to delineated areas (polygons), and verify delineations and attributes through site surveys. In certain areas, there may be repeated site visits to verify multiple cropping.
4. Digitize the map lines in AutoCAD and add attributes.
5. Process and tabulate the data through GIS software (includes checking digital line work and land use attributes for accuracy, and aggregating data from digitized maps into GIS format).

Under standardized procedures developed by the Division of Planning, DWR districts complete steps 1 through 4. The Division's Statewide Planning Branch completes Step 5, in conjunction with field staff. The Division analyzes the data using Geographic Resources Analysis Support System (GRASS) software, a raster GIS. The Division returns the processed data to the districts for local and regional analysis, and for incorporating the information into various work products. Land use data may be analyzed by county, water district, or other political or hydrologic boundaries as needed. The land use legend (see Appendix 1) identifies the general classifications used in these surveys. Acreage statistics files from all DWR land use surveys are maintained by the Division of Planning in Sacramento.

General Nature of the Study Area

The study area for this report includes the valley floor of Fresno County. The San Joaquin Valley is bounded on the east by the Sierra Nevada foothills and on the west by the Coast Range foothills. That part of the study area which is on the San Joaquin Valley floor is in the center of the valley. Fresno County consists of 5,963 square miles of land area, 52 percent of which is in the study area. The study area contains about 1,700,000 acres of which over 1,300,000 are currently developed for irrigated agriculture.

Table 1. Estimated Population of Major Cities and Towns

Area	July 1994
Clovis	61,200
Fresno	393,100
Total Eastside	**684,300**
Coalinga	9,450
Firebaugh	5,375
Huron	5,500
Mendota	7,450
Total Westside	**38,400**
County Total	**739,800**

The study area is roughly divided in half by the San Joaquin Valley trough. About 95 percent of both the population and the trees and vine crops are east of the trough. The area west of the trough is dominated by field and truck crops and is sparsely populated.

The July 1994 population of Fresno County was about 739,800, of which 98 percent is in the study area. Eastside population is mostly concentrated in the rapidly growing Fresno–Clovis metropolitan area. There are a number of smaller towns on the eastside which are also very important to the area's agricultural economy. Westside population is located mostly in the towns of Coalinga, Huron, Mendota, and Firebaugh. Estimated populations for these communities are compared in Table 1.

The terrain in the area is generally flat and smooth, and the eastside slopes gently from the Sierra Nevada foothills to the trough. The young alluvial soils are derived primarily from granitic parent material in the Sierra Nevada. The westside slopes somewhat more steeply from the Coast Range foothills to the trough. Young alluvial soils on the westside are derived primarily from sedimentary parent material in the Coast Range.

The study area's climate is conducive to agricultural production; agriculture is the dominant industry in the area. Summer temperatures are very hot, with the maximum temperature often exceeding 100 degrees Fahrenheit. Winters are marked by moderate temperatures and relatively light rainfall, both of which contribute to the long growing season. The length of the growing season averages about 300 days.

Average annual precipitation ranges from 12–14 inches on the valley's eastside to 6–8 inches on the westside. Total precipitation measured at four U.S. Weather Service stations in the study area is shown in Table 2.

Table 2. Average Annual Precipitation in Fresno County at Selected Stations

Station	Elevation (ft.)	Precipitation (inches) 1994	Precipitation (inches) Average
Friant	410	13.61	13.77
Fresno	336	10.12	10.60
Westhaven	285	7.40	6.94
Coalinga	670	6.40	7.82

Fresno County is the most productive agricultural county in the United States. In 1994, the gross value of agricultural production was just over $3 billion. A combination of fertile soils, available water, favorable climate, and expert farmers are responsible for this.

Fresno County is the center of the U.S. raisin industry; the majority of grapes that supply this industry are found within a 30–mile radius of Fresno. About one–third of the U.S. supply of processing tomatoes is grown in Fresno County. Fresno County no longer is the center of fig production. The tremendous urban development around the cities of Fresno and Clovis has displaced fig plantings. The fig industries' major plantings have shifted north into Madera County.

The Kings River supplies most of the surface water for the eastside through a network of canals. However, conjunctive use of ground and surface water supplies provide a sustainable long–term supply of agricultural and urban water. A relatively small amount of San Joaquin River water is used, mostly through the federal Friant–Kern Canal. Surface water is provided to the westside by the federal San Luis and Delta–Mendota canals.

Fresno County Land Use Survey

The 1994 DWR land use survey of Fresno County is based on over 3,500 exposures of 35 mm aerial slide photography taken during late June and covered all or parts of 65 USGS quadrangle map areas of the study area. There are 137 total quads overlying the county. The surveyed USGS quadrangle maps—called quads—are indexed in Appendix 3. Appendix 3 also includes representative reduced copies of quadrangle maps showing field boundaries and land use codes (attributes) surveyed during the 1994 survey. These photos were used in preparing field boundary maps, as described in the general procedures summarized in Appendix 4, Mapping Procedure and Data Processing.

DWR maps are digitized using AutoCAD and are processed using the Geographic Resources Analysis Support System (GRASS), a raster GIS. It is important that data developed for GIS are in a standardized format to ensure efficient data processing. Therefore, DWR District staff who develop the digital data follow uniform procedures for drawing land use boundaries and entering land use codes into the files.

Results of the data developed from the 1994 survey and processed in GRASS GIS software are summarized in Table 3. This table also compares the 1994 survey results to the two prior surveys conducted in 1986 and 1979. Figure 1 is a bar chart derived from information in Table 3, comparing the composition of the three most recent surveys. Figure 1 illustrates growth in permanent crops, truck crops, and urban development, as well as a corresponding decline in grain and field crops between 1979 and 1994. A detailed summary of the data by crops and other land use categories is found in Appendix 2.

Findings

Figure 2 is a spatial summary of the compiled data for the 1994 Fresno County survey. For areas with multiple (sequential) croppings, the second crop is not represented in Figure 2. For areas with intercropping (simultaneous), Figure 2 represents the permanent crop (trees or vines).

Figure 3 shows changes in land use between the 1986 and 1994 surveys. This type of spatial change detection is made possible by GIS technology as applied to the DWR land use survey program.

In Table 4, results of the 1994 survey are compared with results of the 1986 survey by Detailed Analysis Units[1]. The DAU boundaries are shown in Figure 4.

Table 3 shows that while total land acreage in crops decreased, there was a marked increase in tree and vine acreage, and as would be expected, an increase in urban acreage. Truck crops acreage has increased while field crops and native vegetation have decreased since the 1986 survey.

The largest increase in trees and vines acreage was in almond orchards. Vineyard acreage also increased, but almost all of that increase took place between 1979 and 1986. Plum and prune orchard acreage experienced a similar increase to that of vineyard during the same time frame. Increases in citrus and olive orchard acreage occurred mostly after 1986.

In the field and truck crop categories, cotton is the largest single crop in the county. Cotton acreage decreased the most in the field category—over 110,000 acres—since 1979, despite an increase in cotton acreage between 1986 and 1994. Grain decreased about 40 percent between 1979 and 1994. Alfalfa hay acreage remained about the same while alfalfa seed acreage decreased about 70 percent. Acreage for several truck crops also increased, including acreages for tomatoes (which more than doubled to over 100,000 acres), and onions and garlic (which increased to 40,000 acres—nearly fourfold the previous acreage).

Table 4 details where the 1986–94 changes occurred within the study area. On the westside, where urban pressure is negligible, total acreage of field and truck and total land acreage in crops remained about the same. However, the westside experienced a decrease in grain acreage and increases in cotton and truck crop acreages. Also on the westside, which has a comparatively small amount of tree and vine acreage as compared to the eastside, still had a 69 percent increase from 1986. Urban acraege increased only slightly.

1. A Detailed Analysis Unit is the smallest study area used by DWR for water demand and water supply analyses of water demand and supply. DAUs are generally defined by hydrologic features or boundaries of organized water service agencies. In the major agricultural areas, a DAU typically includes 10,000 to 300,000 acres.

Almost all of the study area's decrease in field and truck crop acreage was on the eastside. There was also a decrease in total land acreage in crops on the eastside. Despite this, tree and vine acreage increased significantlly, approximately by 16,400 acres. There was a large increase in urban acreage, almost 33,000 acres, and a decrease in native vegetation, about 37,000 acres.

Figures 5 and 6 are graphical summaries of acreage changes between the 1958 and 1994 surveys for field and truck crops, trees and vines, cropped area, cultivated area, urban area, and native vegetation for the eastside and westside, respectively.

Availability of Data

After survey data are quality controlled and tabulated, the resulting land use maps and data become permanent records, and are on file at the DWR District Offices in the Land and Water Use Section, Division of Planning, in Sacramento. Questions about the Fresno County land use survey may be directed to the San Joaquin District (see Appendix 5, DWR District Boundaries). Non–digital reports and maps are also available for inspection. Land use survey data for other counties are available at the appropriate DWR District Offices and the Division of Planning in Sacramento.

Table 3. Fresno County Land Use Surveys
Changes in Land Use[1]
(acres x 1,000)

	1979	1986	1994	Change 1979–94	Change 1986–94
Irrigated Crops					
Grain	140.2	125.0	84.5	(55.8)	(40.5)
Rice	13.1	8.7	4.8	(8.3)	(3.9)
Cotton	486.8	338.7	374.5	(112.3)	35.8
Safflower	29.0	15.9	21.0	(8.0)	5.1
Sugar Beets	21.2	31.7	15.3	(5.9)	(16.4)
Corn	23.0	34.2	21.7	(1.3)	(12.6)
Grain Sorghum	4.1	4.0	0.0	(4.1)	(4.0)
Dry Beans	14.4	13.8	1.5	(12.9)	(12.2)
All Other Field	1.9	2.7	2.5	0.5	(0.3)
Alfalfa Hay	75.4	78.7	78.0	2.6	(0.7)
Alfalfa Seed	35.0	47.9	9.5	(25.6)	(38.5)
Pasture	28.1	24.4	17.7	(10.4)	(6.7)
Subtotal Grain & Field Crops[2]	**872.3**	**725.7**	**630.9**	**(241.4)**	**(94.9)**
Lettuce	6.0	7.7	17.3	11.3	9.5
Melons	26.2	41.6	42.6	16.4	1.0
Onions & Garlic	10.9	23.0	40.5	29.6	17.4
Tomatoes	47.2	69.6	107.7	60.4	38.1
All Other Truck	12.0	17.4	11.2	(0.9)	(6.2)
Subtotal Truck Crops	**102.3**	**159.4**	**219.2**	**116.9**	**59.8**
Peaches & Nectarines	33.3	29.6	34.8	1.6	5.3
Plums & Prunes	13.5	23.4	24.8	11.2	1.4
Figs	8.0	6.4	3.6	(4.4)	(2.9)
Almonds	29.9	35.0	51.0	21.1	16.0
All Other Deciduous	8.6	14.7	18.4	9.8	3.7
Citrus & Olives	24.3	26.0	30.8	6.4	4.8
Vineyard	226.7	242.4	242.6	15.9	0.2
Subtotal Trees and Vines	**344.4**	**377.5**	**405.9**	**61.6**	**28.5**
Total Irrigated Crop Acreage	**1,319.0**	**1,262.6**	**1,256.0**	**(63.0)**	**(6.6)**
Double Crop	5.0	8.7	25.3	20.3	16.5
Total Irrigated Land Acreage Cropped	**1,314.0**	**1,253.9**	**1,230.7**	**(83.3)**	**(23.2)**
Irrigated Fallow & Idle	28.4	93.3	95.0	66.6	(1.7)
Nonirrigated Crops & Fallow	17.0	6.9	1.7	(15.3)	(5.2)
Farmsteads & Feedlots	12.1	15.3	13.6	1.5	(1.7)
Urban[3]	85.6	100.0	136.9	51.3	36.9
Native Vegetation	294.1	280.6	206.6	(87.5)	(74.0)

[1] Includes gross acres of major land use categories. Acreage represents the total areas of delineated land use types. Actual planted acreage is less due to the existence of roads, farmsteads, etc.

2 Subtotals may not total due to rounding of component numbers.

[3] Includes residential, commercial, industrial, parks, cemeteries, and golf courses.

Figure 1. Fresno County Land Use Comparison, 1979 to 1994

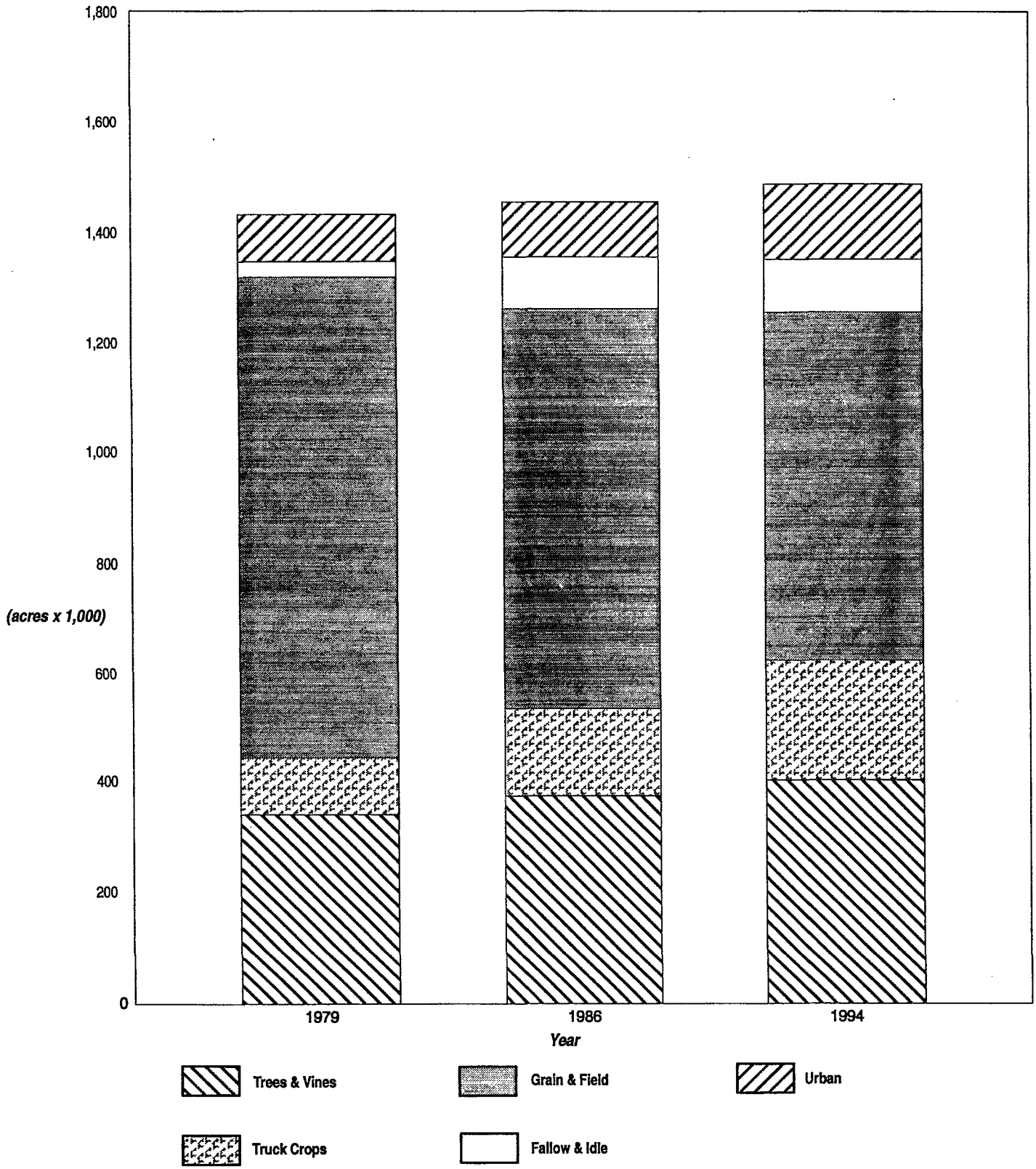


Figure 2. 1994 Fresno County Land Use Survey

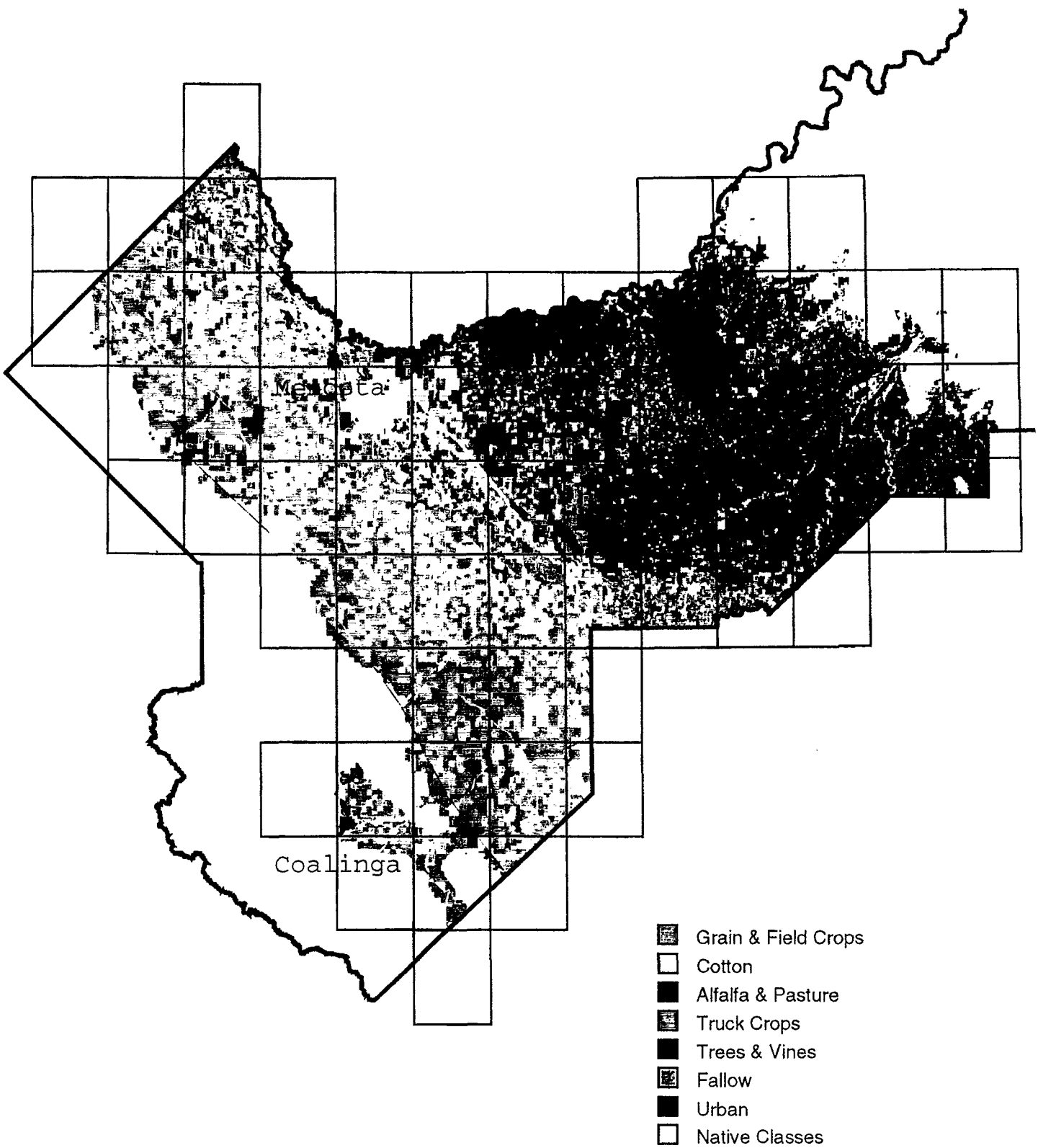


Figure 3. Land Use Change, 1986 to 1994

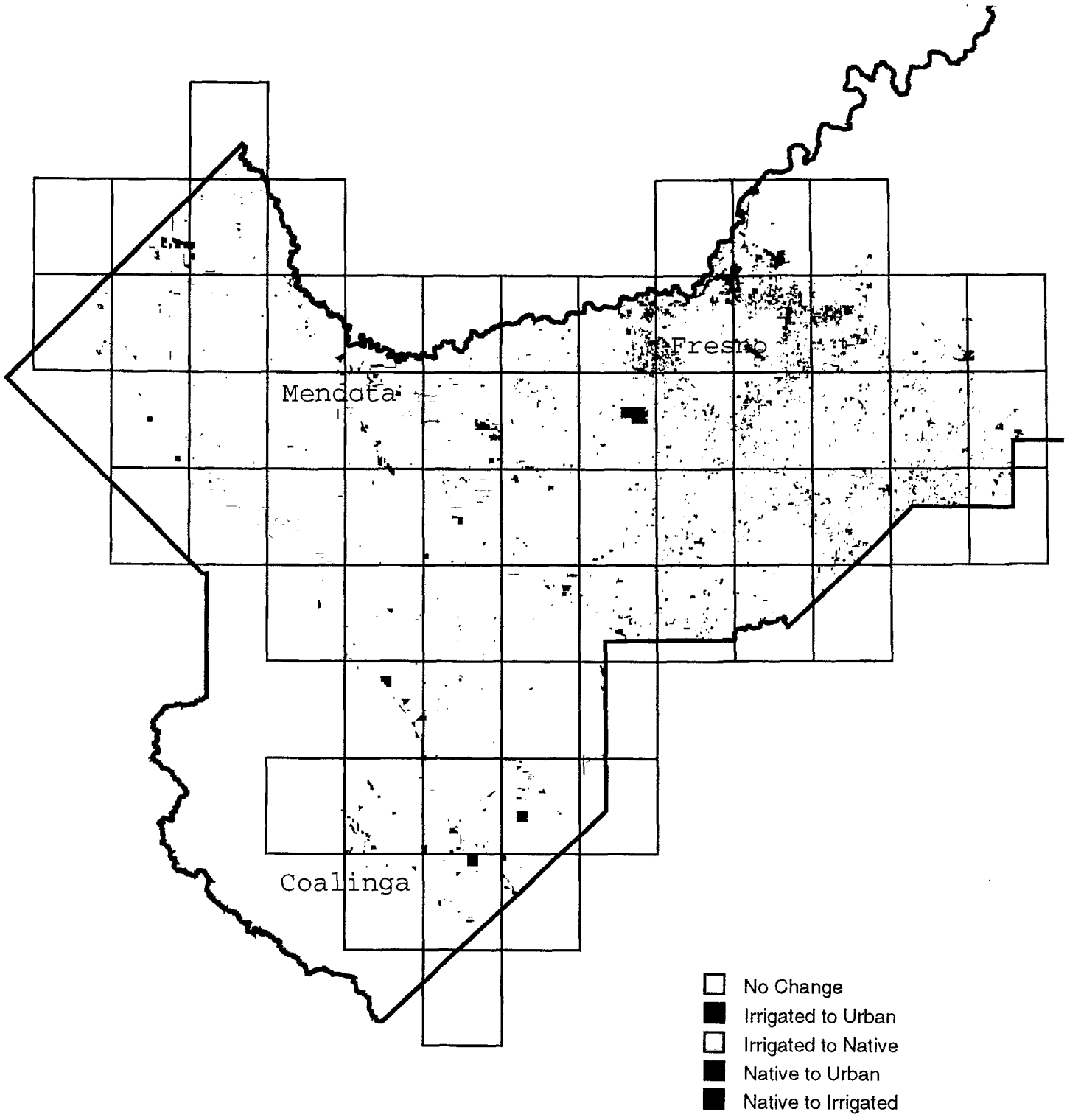


Figure 4. Detailed Analysis Units within the Fresno County Study Area

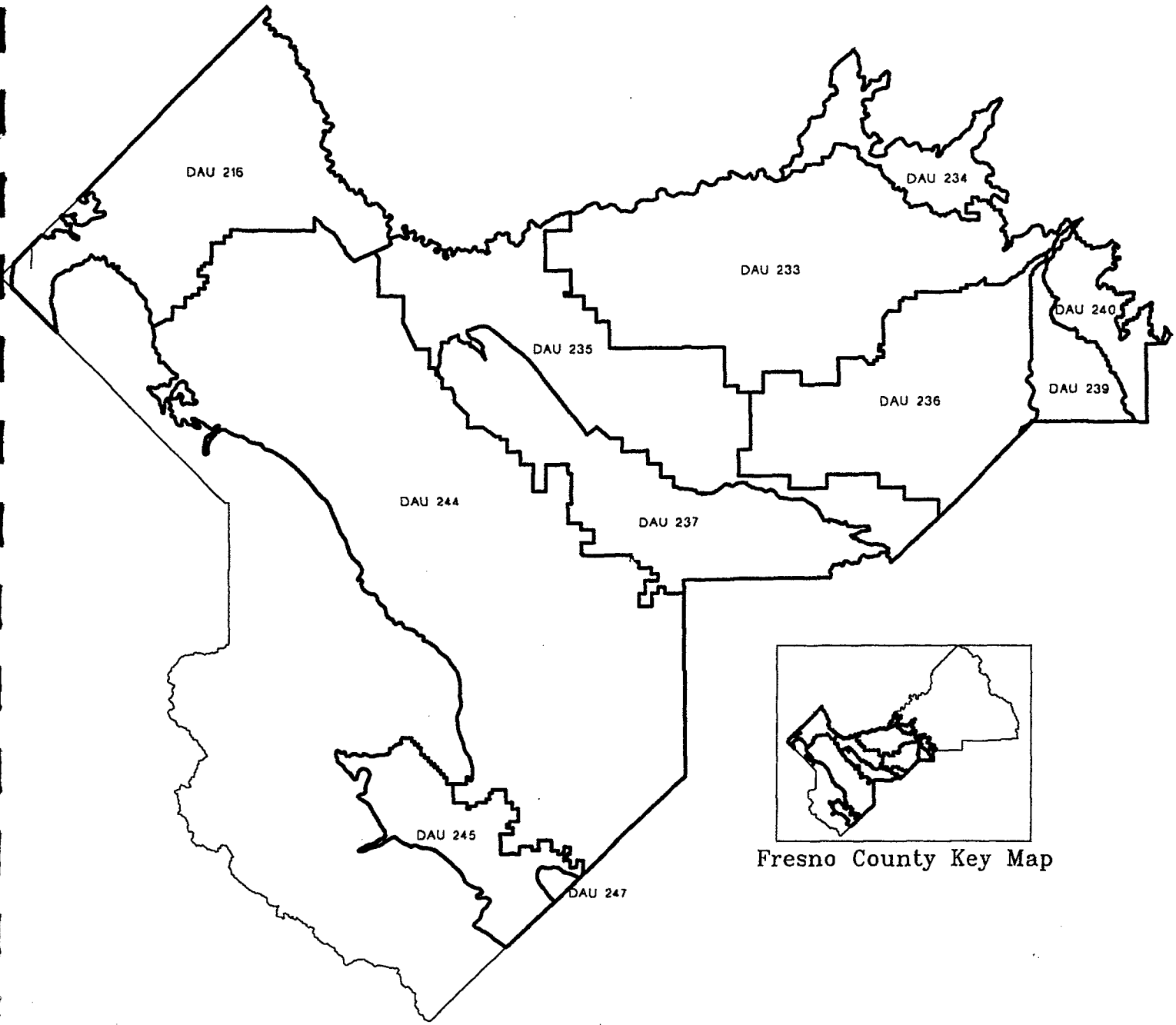


Table 4. Fresno County Valley Floor

(gross acres)

	Eastside													
	DAU 233		DAU 234		DAU 235		DAU 236		DAU 237		DAU 239		DAU 240	
Land Use	1986	1994	1986	1994	1986	1994	1986	1994	1986	1994	1986	1994	1986	1994
Irrigated Crops														
Grain	3,557	2,509	3,585	976	8,966	6,012	252	796	17,316	12,214	591	470	664	317
Rice	0	0	0	0	197	0	0	0	173	0	0	0	0	0
Cotton	11,625	9,168	0	3	27,417	24,176	554	154	35,944	52,523	32	83	419	406
Safflower	0	0	0	0	311	754	0	0	822	1,908	0	0	0	0
Sugar Beets	0	0	0	0	2,583	514	0	0	2,199	2,905	0	0	0	0
Corn	4,045	3,166	254	86	5,443	3,750	521	317	12,171	9,860	174	145	31	4
Grain Sorghum	279	0	0	0	2,456	0	0	0	670	0	95	0	0	0
Dry Beans	557	257	8	0	2,970	320	213	206	855	334	0	0	0	0
All Other Field	644	40	0	0	81	1,242	528	62	532	1,066	0	0	39	0
Alfalfa	11,120	8,034	44	68	29,711	27,543	1,291	1,261	17,495	17,815	86	20	0	27
Alfalfa Seed	53	0	0	0	2,770	0	0	0	24,818	8,895	0	0	0	0
Pasture	10,433	7,552	1,497	1,071	1,577	801	4,041	3,626	3,357	1,626	1,416	1,508	294	399
Lettuce	73	263	0	0	0	0	5	10	0	154	0	0	0	0
Melons	636	202	0	158	572	612	308	150	1,027	689	68	8	0	9
Onions & Garlic	192	75	0	0	103	27	88	94	386	1,889	4	0	0	0
Tomatoes	37	0	44	0	22	1,114	136	2	403	2,702	2	0	0	0
All Other Truck	4,126	6,235	111	222	932	345	1,014	971	225	42	346	206	41	11
Peaches & Nectarines	5,409	4,632	194	229	3,637	5,450	13,426	16,644	173	298	6,110	6,792	635	548
Plums & Prunes	4,189	3,812	72	118	1,311	2,985	10,228	10,243	144	593	6,368	5,960	861	720
Figs	5,704	3,311	401	268	0	0	94	0	0	0	22	0	226	0
Almonds	11,241	11,948	1,023	925	10,751	14,509	609	3,555	2,195	3,927	715	555	683	490
All Other Deciduous	2,022	2,117	527	544	1,435	2,652	6,503	3,665	380	1,488	680	1,192	487	561
Citrus & Olives	7,720	9,521	2,017	2,340	103	83	620	1,101	0	14	2,869	3,644	12,220	13,468
Vineyard	79,514	77,321	827	876	42,356	49,020	96,515	92,540	9,058	10,080	6,038	4,223	1,875	1,667
Total Crop Acreage	**163,176**	**150,163**	**10,596**	**7,884**	**145,704**	**141,918**	**136,946**	**135,397**	**130,343**	**131,022**	**25,616**	**24,806**	**18,475**	**18,627**
Double Crop	181	50	0	0	893	100	95	0	354	1,736	0	110	0	0
Total Land Acreage Cropped	**162,995**	**150,113**	**10,596**	**7,884**	**144,811**	**141,818**	**136,851**	**135,397**	**129,989**	**129,286**	**25,616**	**24,696**	**18,475**	**18,627**
Irrigated Fallow & Idle	10,944	12,006	445	1,630	9,265	8,924	5,612	6,311	6,526	7,322	1,491	1,696	765	515
Nonirrigated Grain & Fallow	283	0	42	368	0	0	0	0	0	0	0	0	0	210
Farmsteads, Feedlots & Dairies	4,019	3,852	627	297	2,428	1,872	1,886	2,193	3,209	2,936	431	396	239	235
Parks, Cemeteries & Golf Courses	2,866	1,852	338	541	202	1,608	525	674	112	1,164	249	323	39	79
Urban	63,586	83,048	3,935	9,767	2,081	4,056	9,776	12,904	2,529	3,118	2,401	3,700	703	1,169
Native Vegetation	26,121	12,463	34,454	26,545	27,644	26,985	7,672	6,949	8,080	5,582	4,374	3,597	26,443	15,158
Total Land Area	**270,814**	**263,334**	**50,437**	**47,032**	**186,431**	**185,263**	**162,322**	**164,428**	**150,445**	**149,408**	**34,562**	**34,408**	**46,664**	**35,993**

Table 4. Fresno County Valley Floor, continued

(gross acres)

Eastside Total		Westside										County Total	
		DAU 216		DAU 244		DAU 245		DAU 247		Westside Total			
1986	1994	1986	1994	1986	1994	1986	1994	1986	1994	1986	1994	1986	1994
34,931	23,294		10,250	59,893	36,102	17,571	14,816	0	0	77,464	61,168	112,395	84,462
370	0	8,170	4,774	162	0	0	0	0	0	8,332	4,774	8,702	4,774
75,991	86,513	52,355	70,671	202,553	210,070	7,774	7,214	0	0	262,682	287,955	338,673	374,468
1,133	2,662	1,719	2,246	13,049	14,479	0	1,611	0	0	14,768	18,336	15,901	20,998
4,782	3,419	14,108	4,181	12,792	6,198	8	1,541	0	0	26,908	11,920	31,690	15,339
22,639	17,328	4,245	1,916	7,361	2,438	0	0	0	0	11,606	4,354	34,245	21,682
3,500	0	169	0	361	0	0	0	0	0	530	0	4,030	0
4,595	1,126	3,605	0	5,572	401	0	0	0	0	9,177	401	13,772	1,527
1,824	2,410	491	6	417	38	0	0	0	0	908	44	2,732	2,454
59,747	54,768	11,140	15,661	7,752	7,488	31	73	0	0	18,923	23,222	78,670	77,990
27,641	8,895	1,203	0	18,988	573	108	0	0	0	20,299	573	47,940	9,468
22,615	16,583	854	492	633	443	309	182	0	0	1,796	1,117	24,411	17,700
78	427	0	0	7,649	16,686	0	160	0	0	7,649	16,846	7,727	17,273
2,611	1,828	12,802	16,831	26,228	23,948	0	0	0	0	39,030	40,779	41,641	42,607
773	2,085	510	2,002	21,750	35,941	0	441	0	0	22,260	38,384	23,033	40,469
644	3,818	9,170	13,049	59,782	90,781	0	6	0	0	68,952	103,836	69,596	107,654
6,795	8,032	1,231	1,544	9,363	1,574	5	0	0	0	10,599	3,118	17,394	11,150
29,584	34,593	0	0	0	256	0	0	0	0	0	256	29,584	34,849
23,173	24,431	227	241	0	83	0	0	0	0	227	324	23,400	24,755
6,447	3,579	0	0	0	15	0	0	0	0	0	15	6,447	3,594
27,217	35,909	482	1,602	7,319	13,482	0	2	0	0	7,801	15,086	35,018	50,995
12,034	12,219	317	480	2,351	5,633	8	62	0	0	2,676	6,175	14,710	18,394
25,549	30,171	291	279	132	330	0	0	0	0	423	609	25,972	30,780
236,183	235,727	71	625	6,088	6,224	11	3	0	0	6,170	6,852	242,353	242,579
630,856	**609,817**	**123,160**	**146,850**	**470,195**	**473,183**	**25,825**	**26,111**	**0**	**0**	**619,180**	**646,144**	**1,250,036**	**1,255,961**
1,523	1,996	491	2,118	6,705	20,864	0	287	0	0	7,196	23,269	8,719	25,265
629,333	**607,821**	**122,669**	**144,732**	**463,490**	**452,319**	**25,825**	**25,824**	**0**	**0**	**611,984**	**622,875**	**1,241,317**	**1,230,696**
35,048	38,404	17,499	9,182	37,831	41,985	2,895	5,397	0	0	58,225	56,564	93,273	94,968
325	578	85	0	1,168	0	5,317	1,152	0	0	6,570	1,152	6,895	1,730
12,839	11,781	840	465	1,402	1,226	263	148	0	0	2,505	1,839	15,344	13,620
4,331	6,241	64	30	100	201	114	60	0	0	278	291	4,609	6,532
85,011	117,762	2,733	3,471	5,899	6,457	1,791	2,715	0	0	10,423	12,643	95,434	130,405
134,788	97,279	34,225	23,097	58,100	50,737	50,630	32,266	2,879	3,251	145,834	109,351	280,622	206,630
901,645	**879,866**	**178,115**	**180,977**	**567,990**	**552,925**	**86,835**	**67,562**	**2,879**	**3,251**	**835,819**	**804,715**	**1,737,494**	**1,684,581**

Figure 5. Fresno County Land Use — Westside, 1958–1994

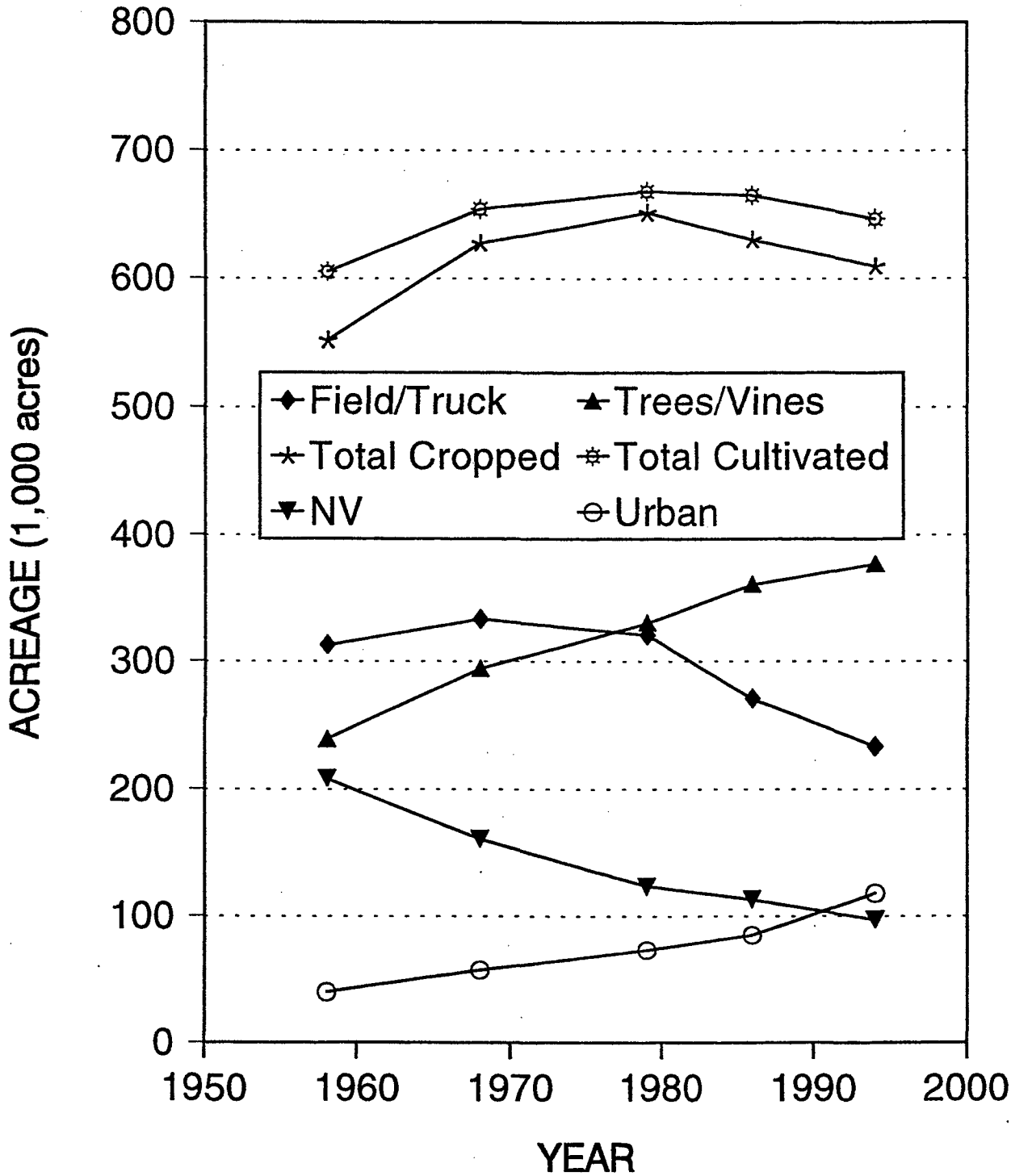
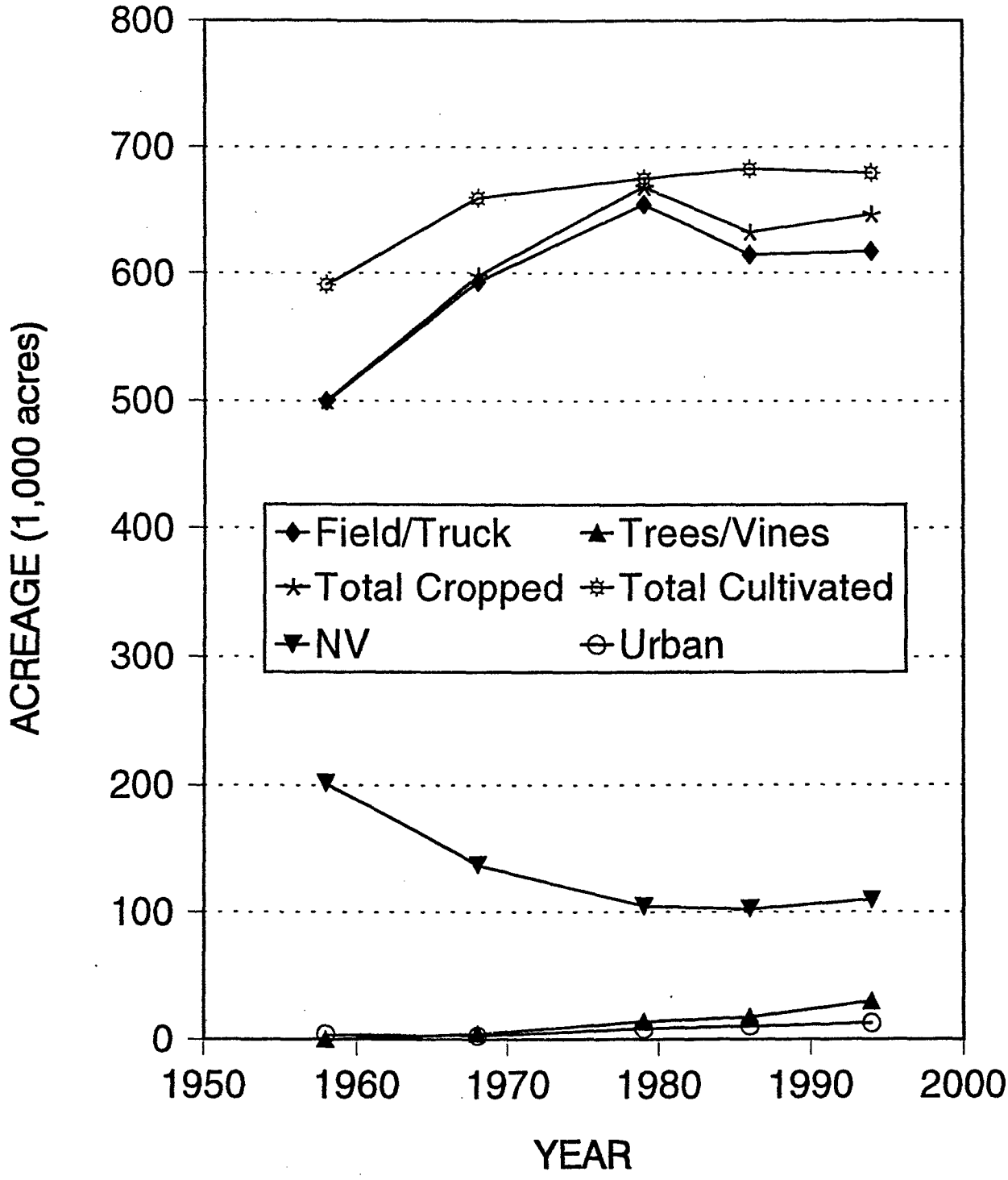


Figure 6. Fresno County Land Use — Eastside, 1958–1994



Appendix 1. Land Use Legend

Agricultural Classes

C – Subtropical Fruits

1. Grapefruit
2. Lemons
3. Oranges
4. Dates
5. Avocados
6. Olives
7. Misc. subtropical
8. Kiwi fruits
9. Jojoba
10. Eucalyptus

D – Deciduous Fruits and Nuts

1. Apples
2 Apricots
3. Cherries
5. Peaches and Nectarines
6. Pears
7. Plums
8. Prunes
9. Figs
10. Misc. deciduous
12. Almonds
13. Walnuts
14. Pistachios

G – Grain and Hay Crops

1. Barley
2. Wheat
3. Oats
6. Misc. and mixed hay and grain

F – Field Crops

1. Cotton
2. Safflower
3. Flax
4. Hops
5. Sugar beets
6. Corn (Field or sweet)
7. Grain sorghum
8. Sudan
9. Castor beans
10. Beans (dry)
11. Misc. field
12. Sunflowers

T – Truck and Berry Crops

1. Artichokes
2. Asparagus
3. Beans (green)
4. Cole crops
6. Carrots
7. Celery
8. Lettuce (all types)
9. Melons, squash, and cucumbers (all types)
10. Onions and garlic
11. Peas
12. Potatoes
13. Sweet Potatoes
14. Spinach
15. Tomatoes
16. Flowers and nursery
17. Mixed (four or more)
18. Misc. truck
19. Bushberries
20. Strawberries
21. Peppers (chili, bell, etc.)
22. Broccoli
23. Cabbage
24. Cauliflower
25. Brussels sprouts

P – Pasture

1. Alfalfa & alfalfa mixtures
2. Clover
3. Mixed pasture
4. Native pasture
5. Induced high water native pasture
6. Misc. grass
7. Turf farms

R – Rice

V – Vineyards

S – Semiagricultural and Incidental To Agriculture

1. Farmsteads
2. Feed lots – livestock
3. Dairies
4. Poultry Farms

I – Idle

1. Land cropped within the past three years but not tilled at the time of survey.
2. New lands being prepared for crop production.

Double Crops

First crop indicated by enclosed parenthesis. *Example*: (iG) iF6 = irrigated grain followed by field corn.

Intercropping

Indicated by a fractional symbol. *Example*: D5/G1 = peaches intercropped with barley.

Mixed Land Use

Indicated by percentages following land use symbols. *Example*: iD540 NV 60 (Forty percent peaches and 60 percent native vegetation.)

Appendix 1. Land Use Legend, continued

Urban Classes

U – Urban
Used alone when further breakdown is not required)

UC – Urban Commercial
1. Miscellaneous (offices and retailers)
2. Hotels
3. Motels
4. Recreational Vehicle Parking
5. Institutions
6. Schools
7. Municipal auditoriums theaters, etc.
8. Miscellaneous high water use

UI – Urban Industrial
1. Manufacturing, assembling, and general processing
2. Extractive industries
3. Storage and distribution
6. Saw mills
7. Oil refineries
8. Paper mills
9. Meat packing plants
10. Steel and aluminum mills
11. Fruit and vegetable canneries and general food processing
12. Miscellaneous high water use
13. Sewage treatment plant including ponds.
14. Waste accumulation sites
15. Wind & solar farms

UR – Urban Residential
1. Single family dwellings (1–5 acres)
2. Single family dwellings (1 unit/ac–8 unit/ac)
3. Multiple family dwellings
4. Trailer courts

UV – Urban Vacant
1. Unpaved areas
3. Freeways and railroad right of ways
4. Paved areas
6. Airport runways

UL – Urban Landscape
1. Lawn area (irrigated)
2. Golf course (irrigated)
3. Ornamental landscape (irrigated)
4. Cemeteries (irrigated)
5. Cemeteries (not irrigated)

Native Classes

NV – Native Vegetation
1. Grass land
2. Light brush
3. Medium brush
4. Heavy brush
5. Brush and timber
6. Forest
7. Oak grass land

NC – Native Classes Unsegregated

NR – Riparian Vegetation
1. Marsh lands, tules, and sedges
2. Natural high water table meadow
3. Trees, shrubs, or other larger streamside or water course vegetation
4. Seasonal duck marsh, dry or only partially wet during summer
5. Permanent duck marsh, flooded during summer

NW – Water Surface
Lakes, reservoirs, rivers canals, etc.

NB – Barren and Wasteland
1. Dry stream channels
2. Mine Tailing
3. Barren land
4. Salt flats
5. Sand dunes

Special Conditions

(A) Abandoned Orchards and Vineyards
(F) Fallow Lands
(K) Freeways
(M) Military Areas
(P) Parks
(S) Seed Crop
(T) Tilled Lands
(X) Partially Irrigated Crops
(Y) Young Nonbearing Orchards and Vineyards
(Z) Reclamation

Appendix 2. Summary of 1994 Fresno County Land Use Survey

Land Use	Spec Cond	Irrigated Lands	Non-irrigated Lands	Totals
C 1	*	5	0	
C 2	*	431	0	
C 2	Y	103	0	
C 3	*	28,357	0	
C 3	A	56	0	
C 3	Y	1,960	0	
C 5	*	46	0	
C 6	*	1,354	0	
C 6	A	7	0	
C 6	Y	38	0	
C 7	*	46	0	
C 8	*	419	0	
C 10	*	291	0	
Class total		**33,113**	0	**33,113**
D 1	*	4,499	0	
D 1	Y	306	0	
D 2	*	352	0	
D 2	Y	11	0	
D 3	*	362	0	
D 3	Y	8	0	
D 5	*	32,831	0	
D 5	A	77	0	
D 5	Y	2,046	0	
D 6	*	120	0	
D 7	*	22,905	0	
D 7	A	164	0	
D 7	Y	739	0	
D 8	*	1,142	0	
D 8	Y	12	0	
D 9	*	3,612	0	
D 9	A	285	0	
D **	A	508	0	
D **	Y	1	0	
D 10	*	3,352	0	
D 10	A	78	0	
D 10	Y	464	0	
D 12	*	47,394	0	
D 12	A	168	0	
D 12	Y	3,665	0	
D 13	*	4,382	0	

Appendix 2. Summary of 1994 Fresno County Land Use Survey, continued

Land Use	Spec Cond	Irrigated Lands	Non-irrigated Lands	Totals
D 13	A	32	0	
D 13	Y	220	0	
D 14	*	3,812	0	
D 14	A	17	0	
D 14	Y	511	0	
Class total		**134,075**	**0**	**134,075**
F 1	*	374,870	0	
F 2	*	20,999	0	
F 5	*	15,338	0	
F 6	*	21,683	0	
F 8	*	2,435	0	
F 9	*	6	0	
F 10	*	1,580	0	
F 12	*	11	0	
Class total		**436,921**	**0**	**436,921**
G **	*	84,498	1,760	
Class total		**84,498**	**1,760**	**86,257**
P 1	*	77,990	0	
P 1	S	9,467	0	
P 2	*	45	0	
P 3	*	14,542	0	
P 3	X	172	0	
P 4	*	2,930	0	
P 7	*	76	0	
Class total		**105,222**	**0**	**105,222**
R **	*	4,774	0	
Class total		**4,774**	**0**	**4,774**
T 2	*	1,447	0	
T 4	*	9	0	
T 8	*	17,283	0	
T 9	*	42,826	0	
T 10	*	40,361	0	
T 11	*	33	0	
T 13	*	40	0	
T 15	*	107,653	0	
T 16	*	1,523	0	
T 16	S	41	0	
T 17	*	17	0	
T 18	*	6,726	0	
T 19	*	9	0	
T 20	*	467	0	

Appendix 2. Summary of 1994 Fresno County Land Use Survey, continued

Land Use	Spec Cond	Irrigated Lands	Non-irrigated Lands	Totals
T 21	*	837	0	
Class total		**219,272**	**0**	**219,272**
V **	*	237,718	0	
V **	A	229	0	
V **	Y	4,864	0	
Class total		**242,812**	**0**	**242,812**
CROPPED AG.		***126,068***	***1,760***	***1,262,446***
F **	F	76,728	0	
Class total		**76,728**	**0**	**76,728**
V **	F	4	0	
Class total		**4**	**0**	**4**
FALLOW		***76,732***	***0***	***76,732***
I 1	*	14,974	0	
I 2	*	40	0	
I **	*	1,665	0	
Class total		**16,679**	**0**	**16,679**
IDLE + FALLOW		***93,410***	***0***	***93,410***
S 1	*	0	8,276	
S 2	*	0	1,282	
S 3	*	0	4,086	
Class total		**0**	**13,644**	**13,644**
TOTAL AG.		***1,354,096***	***15,404***	***1,369,500***
NB **	*	0	11	
Class total		**0**	**11**	**11**
NV 1	*	0	128	
NV **	*	0	503,901	
Class total		**0**	**504,029**	**504,029**
NW **	*	0	4,410	
Class total		**0**	**4,410**	**4,410**
NATIVE LANDS		***0***	***508,451***	***508,451***
U **	*	0	89,914	
Class total		**0**	**89,914**	**89,914**
UC 4	*	0	33	
UC 5	*	0	31	
UC 6	*	0	546	
UC 7	*	0	4	
UC **	*	0	9,832	
Class total		**0**	**10,446**	**10,446**

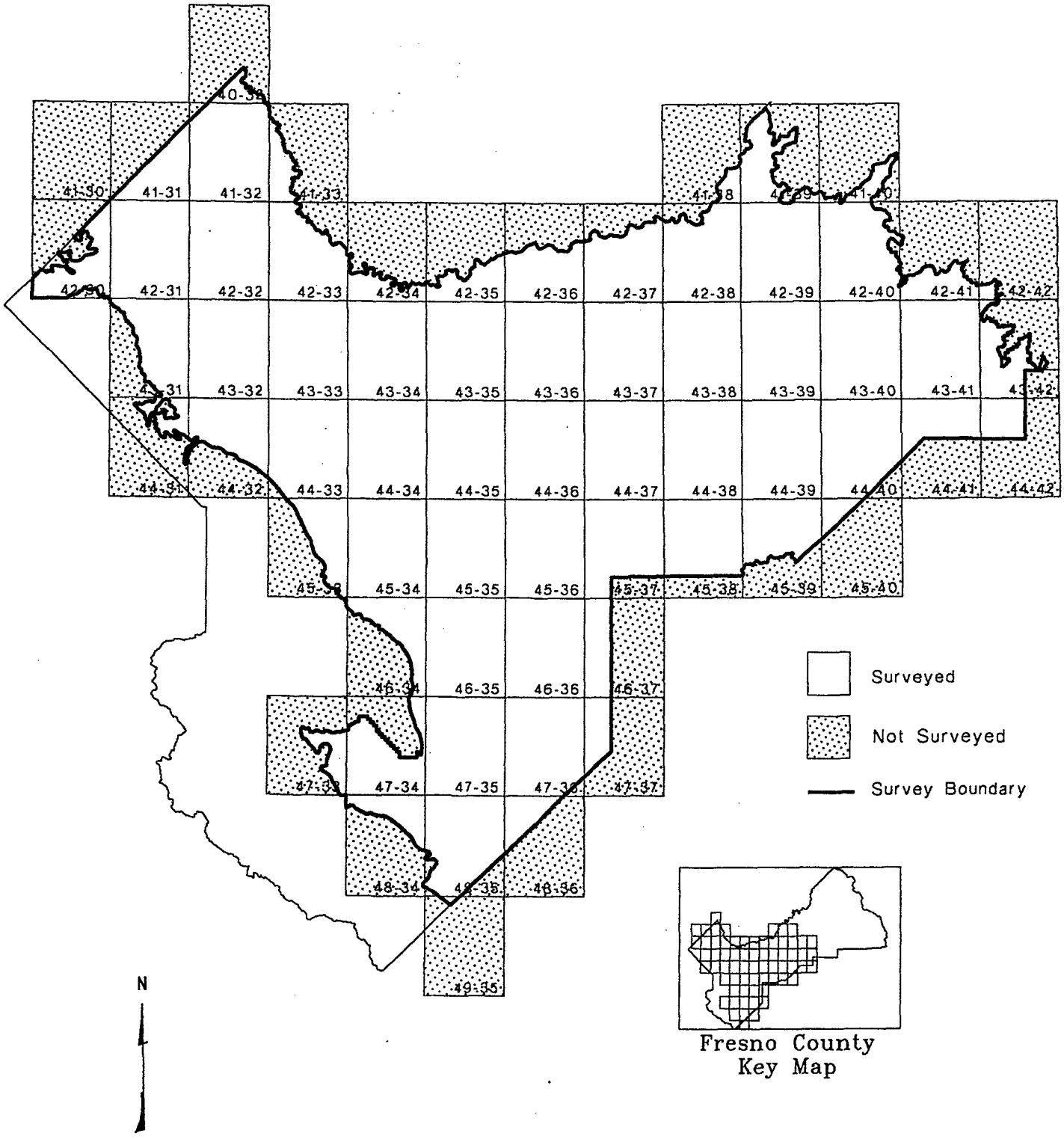
Appendix 2. Summary of 1994 Fresno County Land Use Survey, continued

Land Use	Spec Cond	Irrigated Lands	Non-irrigated Lands	Totals
UI 1	*	0	55	
UI 2	*	0	198	
UI 3	*	0	89	
UI **	*	0	143	
Class total		**0**	**486**	**486**
UL 1	*	0	4,025	
UL 2	*	0	1,235	
UL 4	*	0	372	
UL 5	*	0	51	
UL **	*	0	850	
Class total		**0**	**6,534**	**6,534**
UR 1	*	0	7,542	
UR 2	*	0	400	
UR 3	*	0	40	
UR **	*	0	8,750	
UR 11	*	0	90	
UR 14	*	0	11	
Class total		**0**	**16,833**	**16,833**
UV 1	*	0	141	
UV 6	*	0	1,036	
UV **	*	0	11,043	
UV **	K	0	1,836	
Class total		**0**	**14,056**	**14,056**
URBAN AREAS		***0***	***138,269***	***138,269***
Z **	*	0	317	
Class total		**0**	**317**	**317**
OUTSIDE STUDY AREA		***0***	***317***	***317***
COUNTY TOTALS		***1,354,096***	***662,441***	***2,016,537***

Appendix 3. Fresno County Quadrangle Maps

This appendix includes a map of the study area in Fresno County overlaid by a quadrangle map index. Quads which were surveyed are not shaded; information may be available for shaded quads as part of other land use surveys. Facing the county–quad map is a list by DWR Quad Number and Quad Name of the shaded quads. Following this list are two representative samples of survey data overlaid on the quad maps.

Figure A3–1. Fresno County Quadrangle Map Index



Fresno County Quadrangle Map List

40–32	Santa Rita Bridge	44–31	Tumey Hills
41–30	Charleston School	44–32	Monocline Ridge
41–31	Dos Palos	44–33	Levis
41–32	Oxalis	44–34	Cantua Creek
41–33	Poso Farm	44–35	San Joaquin
41–38	Lanes Bridge	44–36	Helm
41–39	Friant	44–37	Raisin
41–40	Academy	44–38	Caruthers
42–30	Laguna Seca Ranch	44–39	Conejo
42–31	Hammonds Ranch	44–40	Selma
42–32	Broadview Farms	44–41	Reedley
42–33	Firebaugh	44–42	Orange Cove South
42–34	Mendota Dam	45–33	Lillis Ranch
42–35	Gravelly Ford	45–34	Tres Pecos Farms
42–36	Biola	45–35	Westside
42–37	Herndon	45–36	Five Points
42–38	Fresno North	45–37	Burrel
42–39	Clovis	45–38	Riverdale
42–40	Round Mountain	45–39	Laton
42–41	Piedra	45–40	Burris Park
42–42	Pine Flat Dam	46–34	Domengine Ranch
43–31	Chounet Ranch	46–35	Harris Ranch
43–32	Chaney Ranch	46–39	Calflax
43–33	Coit Ranch	46–37	Vanguard
43–34	Tranquillity	47–33	Alcalde Hills
43–35	Jamesan	47–34	Coalinga
43–36	Kerman	47–35	Guijarral Hills
43–37	Kearny Park	47–36	Huron
43–38	Fresno South	47–37	Westhaven
43–39	Malaga	48–34	Kreyenhagen Hills
43–40	Sanger	48–35	Avenal
43–41	Wahtoke	48–36	La Cima
43–42	Orange Cove North	49–35	Garza Peak

UNITED STATES
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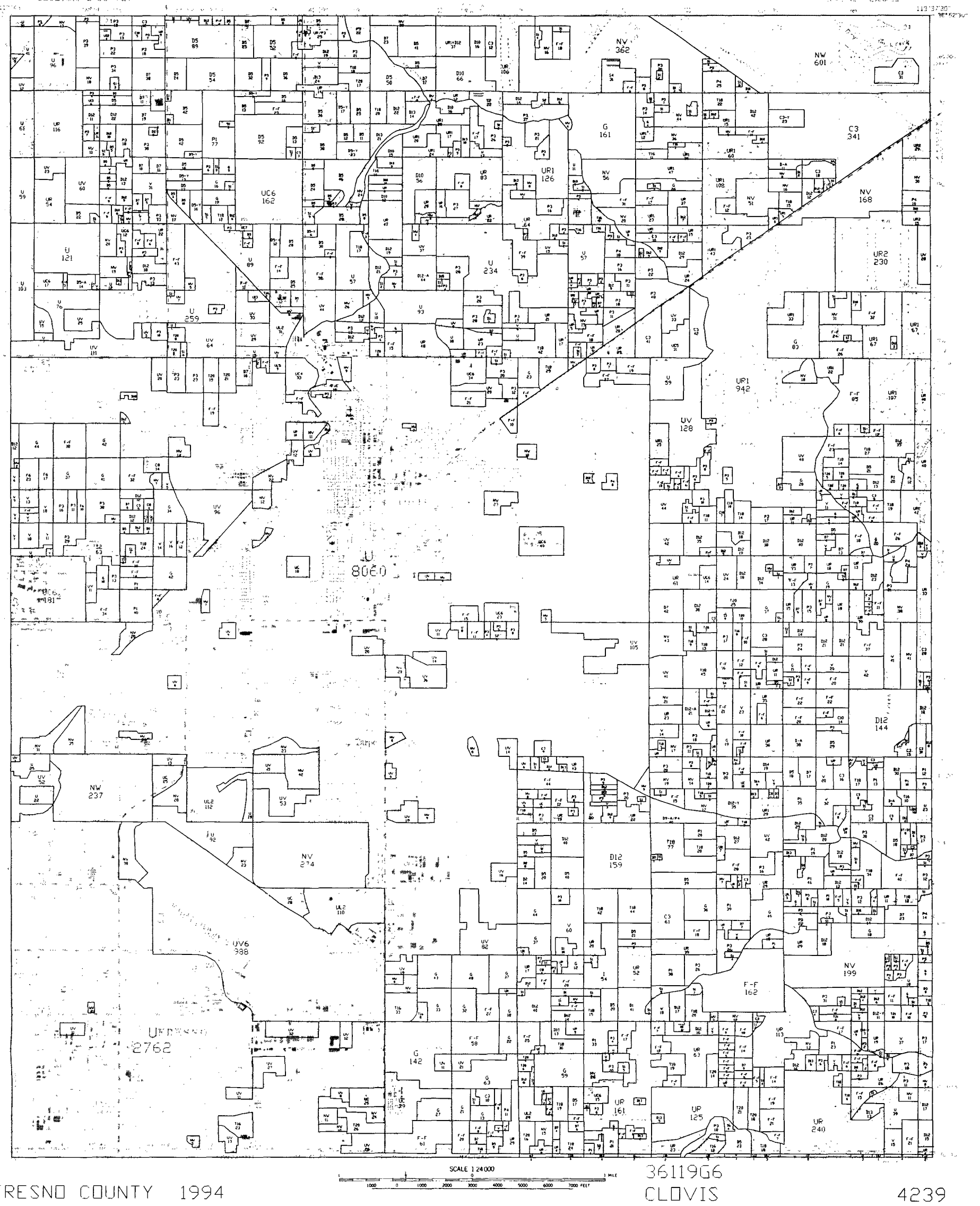
GEOLOGICAL SURVEY

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

CLOVIS QUADRANGLE
CALIFORNIA-FRESNO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



FRESNO COUNTY 1994

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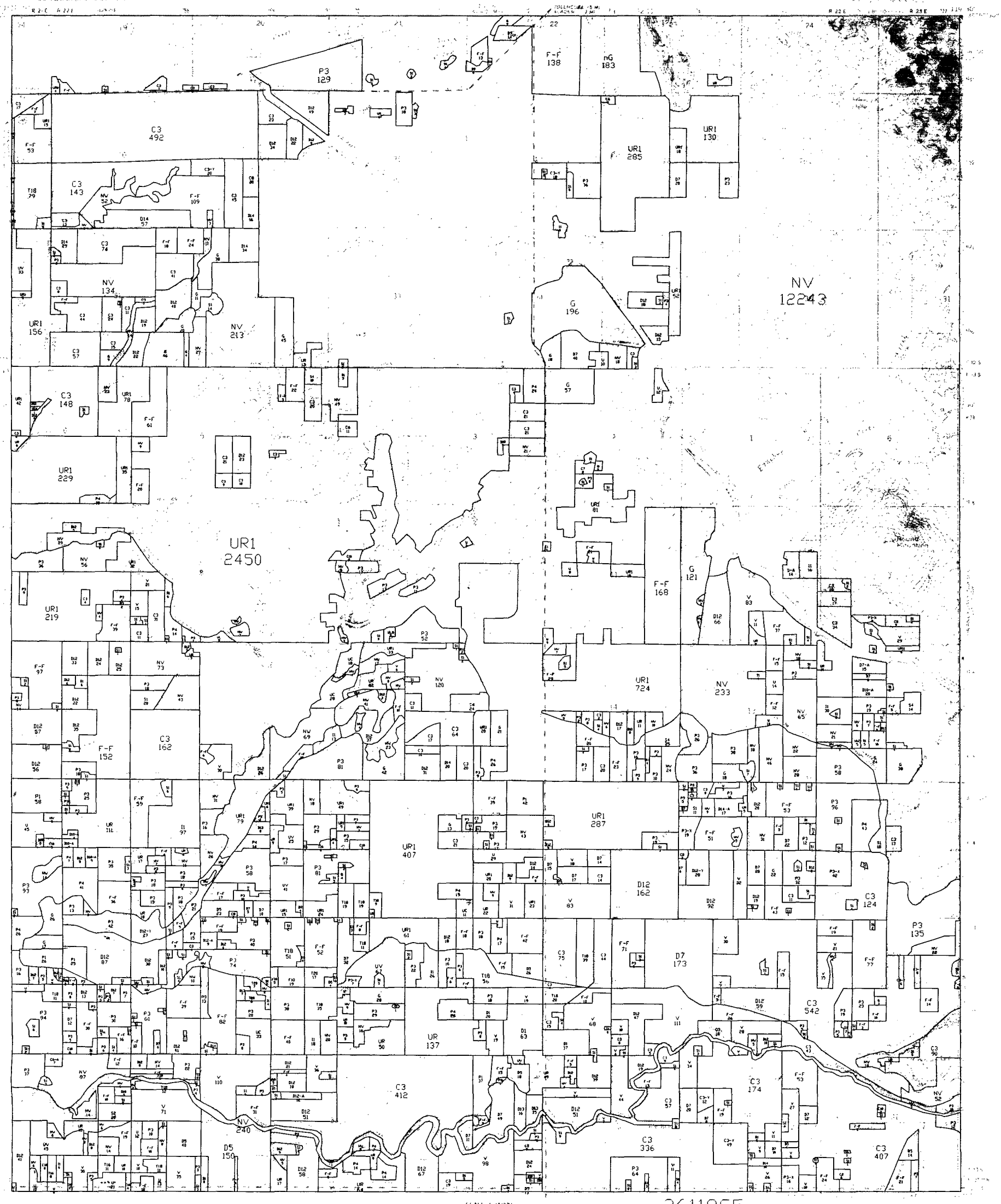
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

ROUND MOUNTAIN QUADRANGLE
CALIFORNIA - FRESNO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



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C-057581

C-057582

Appendix 4. Mapping Procedure and Data Processing

DWR land use maps are developed using standardized DWR cartographic procedures. The digital map files are created in one of three standard transverse Mercator projections: Universal Transverse Mercator (UTM) 10, UTM 11, or CA105 identical to Universal Transverse Mercator except for a small change. The CA105 projection has a central meridian of 120 degrees, while the UTM Zones 10 and 11 have central meridians of 123 degrees and 117 degrees, respectively. CA105 allows the entire state to be mapped in one zone accurately. Files in CA105 may be transformed accurately into other projections.

The base maps used for all DWR land use surveys are U.S. Geological Survey 7-1/2 minute quadrangle maps, on a 1:24,000 scale.

DWR conducts land use surveys using natural color 35 mm slide photography taken from aircraft at an elevation of about 5,500 feet. Flight lines are one mile apart. An average county survey may require three to four days of flying to cover land areas ranging from 700,000 acres to over 1,200,000 acres.

The 35 mm slides are organized into individual flight lines from south to north. Using traditional methods, each slide is projected on screen and field boundaries are manually delineated onto USGS 7-1/2 minute quadrangle maps. Over 3,500 exposures were required to cover the 1994 Fresno County survey study area.

The delineation process takes months to complete, and began in early July. As the delineation process takes place, finished quad maps are taken into the field where each identified field boundary site is located and the crop that is or was growing is identified. Care is taken to ensure the delineated field boundary indeed consists of only one crop, and boundaries are properly located. In some cases, the irrigation method and water source are also identified. Where double cropping occurs, efforts are taken to identify the previous or later crop through additional site visits or other information.

Quad maps returned from the field are then edge checked and proofed to ensure field boundaries and crops properly match between adjacent maps and all delineated fields have a land use class identified. The finished quads are then digitized. County acreage during the non-survey years is updated through various sources.

Data Processing

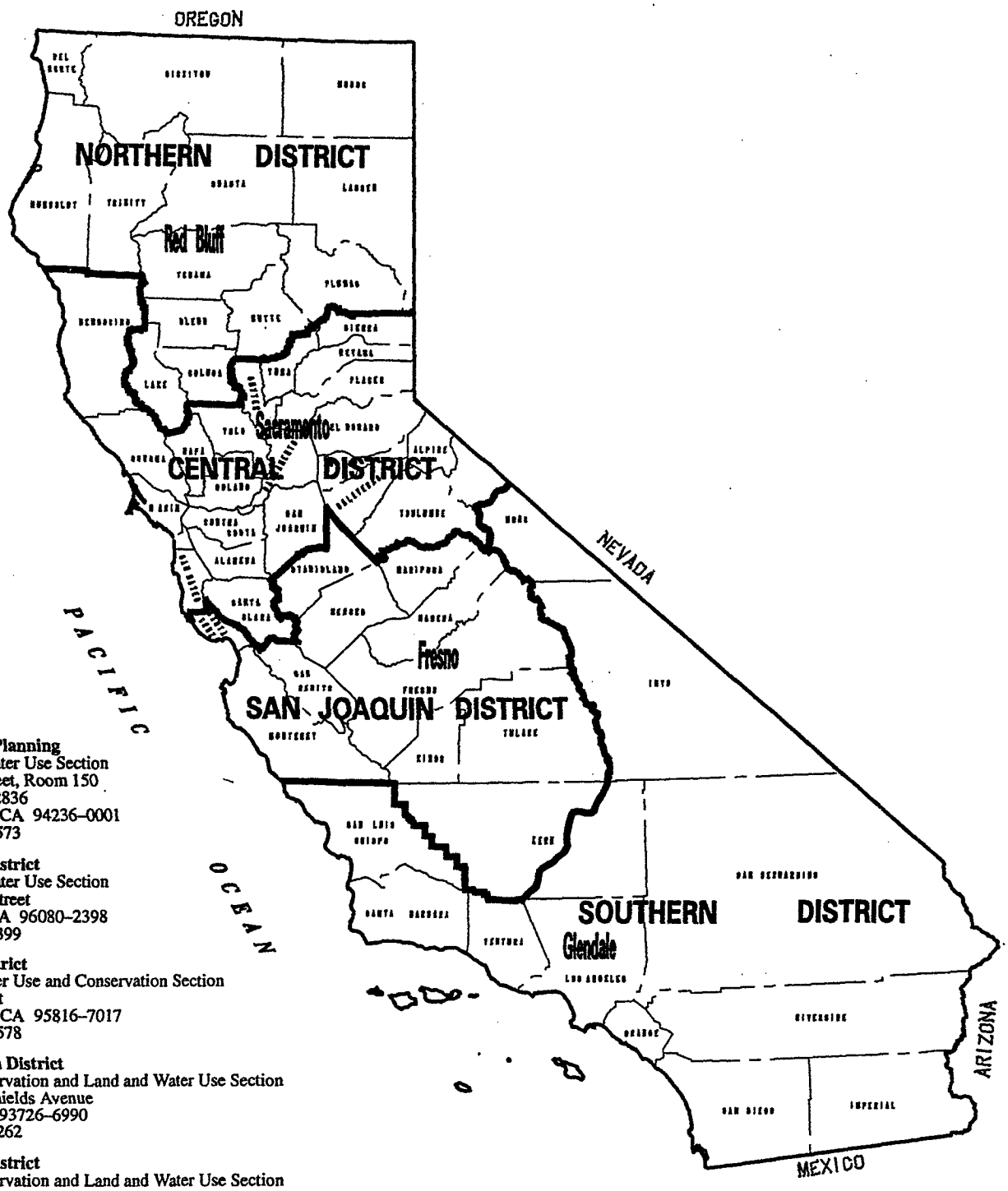
Field boundaries and other boundaries required for DWR's land use survey program are digitized using AutoCAD. This survey data is processed using the Geographic Resources Analysis Support System (GRASS), a raster Geographic Information System. It is important that data developed for a GIS are in a standardized format to ensure efficient data processing. Therefore, DWR District staff who develop the digital data follow uniform procedures for drawing land use boundaries and entering land use codes into the files. Survey data development is also subject to digital line accuracy assessment procedures.

The initial land use data created are quad-sized files in vector format (AutoCAD's native file format, DWG). After undergoing quality control procedures,

the data is used to create two new files, a DXF file (a standard interchange file format) for the linework, and a text file (called an ATT file) that contains a point near the center of each polygon and its attribute (land use code). These files are brought into GRASS, the resulting vector files converted into raster files, and all the raster files are joined together to create the final raster layer of the study area. Concurrently, vector boundaries for quads, county, water district, detailed analysis unit, and other boundaries are developed in AutoCAD, brought into GRASS, and converted into raster format. Various acreage reports can then be created within GRASS by overlaying various boundaries over the land use layer.

Appendix 5. DWR District Boundaries

For more information contact the Division of Planning or the appropriate District offices listed below.



Division of Planning
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1416 9th Street, Room 150
P.O. Box 942836
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Central District
Land & Water Use and Conservation Section
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Sacramento, CA 95816–7017
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San Joaquin District
Water Conservation and Land and Water Use Section
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Fresno, CA 93726–6990
(209) 445–5262

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